

Abstract of the Ph.D. Thesis

^{titled}
”Spatial Models in Small Area
Estimation”

by BHARAT BHUSHAN SINGH

Submitted to Indian Institute of Technology Kanpur

The success of small area techniques in improving such estimates depend on the availability of related exogenous variables, showing strong association with the response variable. In Indian context, reliable administrative and civic registration data at small area levels are too difficult to search out. The thesis focuses on an alternative method to strengthen the direct survey estimators and towards the use of spatial interaction amongst the small area units in the form of spatial models.

The small area characteristics have the spatial dependence in terms of neighborhood similarities. This sort of dependence has been explicitly used in the thesis, in a mixed linear model framework, to explain a portion of the random error unaccounted for and left over by the explanatory variables and thus it has been tried to improve the direct survey estimates simultaneously for all the small areas together. The spatial model utilises a spatial weighing matrix which shows the amount of interaction between any pair of small areas. This may consist of the length of common boundary or inverse of the Euclidean distance between the centers of two small area units.

Under the spatial model, the empirical best linear unbiased predictor (EBLUP) of the characteristics under study, have been obtained for all the small areas simultaneously. A second order approximation to the mean squared error (MSE) of the EBLUP have also been obtained. A simple method of bootstrapping, parametric and non parametric, has been suggested to find out another method of getting estimates of the MSE. An equivalent hierarchical Bayes (HB) model have also been suggested and by assigning diffuse priors to the unknown parameters, the HB estimators of the small area characteristics have been found. In an empirical study, the spatial models along with its two special cases, mentioned above, have been used in providing the improved estimates for data on monthly per capita consumption expenditure (MPCE) and employment rate (ER), as collected by a large scale survey organisation, National Sample Survey Organisation (NSSO), Ministry of Statistics and Programme Implementation, Government of India.

Extension of the spatial model towards the time series data in form of spatial temporal model and towards the multiple of characteristics, in form of multivariate spatial model have also been proposed. The EBLUP estimates of the characteristics have been found. A test statistics to test the significance of the spatial autocorrelation, have been proposed and the asymptotic null distribution of the test statistics has also been found. The test

statistics has been applied on the NSSO data and these have been found to resemble with the likelihood ratio test based on nested likelihoods. An extensive simulation study to see the significance of spatial autocorrelation vis-a-vis the intensity of multiple correlation coefficients between the response variable and the exogenous variable. A brief discussion on the sampling methodology of data collection by NSSO for its various rounds under study have been mentioned.

"The thesis is available in the CSO Library".